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Functional Food: A Brief Overview

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ABSTRACT

Functional food or nutraceuticals is an emerging trend in food and nutrition research. Though the concept is not very new, but application of nutraceuticals to cure human diseases became popular topic of research in recent times. Functional foods contain bioactive ingredients which are beneficial for physiological benefit of human beings and can combat with chronic diseases. Majority of the synthetic drugs have side effects which can adversely affect human health. Functional foods can provide natural remedy to most of the human diseases as well as can prevent them by boosting the immune system of the body. Nutraceuticals have proved their efficacy against cancer, tumours, diabetes, obesity, high blood pressure, premature aging, blood detoxification, etc. Gradually pharmaceuticals are shifting towards nutraceuticals to seek a natural remedy to every health related problems. Different types of fruits, vegetables, fish oils, food supplements, and phytochemicals can act as functional food. Apart from biomedical science, the food industries now-a-days are turning towards functional food additives to improve the flavour, texture, nutritional value of the food stuffs. Through this article an attempt has been made to review the current scenario of functional food.

Keywords: Nutraceuticals, functional food, human health, bioactive ingredients

It is well established that there is a relationship between food intake and heath condition of an individual. The food habit of an individual can modulate the mechanism of metabolism. There are some foods which provide us some other benefits in addition to nutrition. These types of foods are called functional food. Functional foods can be defined as any food that has a positive impact on an individual's health, physical performance, or state of mind, in addition to its nutritious value (Rincón-León, 2003). The functional foods derive from natural ingredients and thus, not taken in form of capsule of tablet, rather consumed as part of diet. They enhance immune system, prevent disease, helps to recover from specific diseased condition, control physical and mental disorders and reported to prevent aging. The term nutraceutical and functional food is often interchangeable. Nutraceuticals include antioxidants, dietary supplements, fortified dairy products, and citrus fruits, and vitamins, minerals, herbals, milk, and cereals (Lee, 2017). Nutraceuticals can fight cancer, diabetes, coronary heart disease, inflammation, high blood pressure, spasmodic disorder, inflammation, etc. A wide range of phytochemicals such as phytoestrogens, phytosterols, terpenoids, carotenoids, limonoids, polyphenols, anthocyanidins,, etc. act as nutraceuticals and have specific pharmacological effects on human health (Sharma *et al.* 2016). Delivery systems of functional foods is important just like drug delivery and several approaches have been adopted to deliver these nutraceuticals into human system which includes nanotechnology, smart polymers that are responsive to stimuli, etc. In this article, we will review some of the most common food or food supplements which act as functional food or nutraceuticals and have direct effect on human health.

Inulin

Inulin is a food supplement which falls under non-α-glucan oligosaccharides (Fan *et al.* 2016). The oligosaccharides are generally sub categorized into two digestible oligosaccharides and non-α-glucan oligosaccharides. The first one includes maltodextrins that are widely used in food industries as fat substitutes, sweeteners and to modify the texture of the food product. The other non-α-glucan oligosaccharides, consisting of inulin and fructo-oligosaccharides (Cummings and Stephen, 2007), are natural ingredients that are widely found in many plants, vegetables, fruits and cereals including leek, onion, wheat, garlic, banana and chicory (Stephen *et al.* 2006). Inulin and fructo-oligosaccharides are called non-digestible oligosaccharides (Roberfroid *et al.*, 1993) as they do not get hydrolysed when they pass through the upper gastrointestinal (GI) system. Inulin and fructo-oligosaccharides reach the colon where they stimulate the development of the bifidus-predominant flora (Coppa *et al.* 2006). Fan *et al.* 2016, reported that inulin try to mimic the bifidogenic effects of human milk by addition of prebiotics. The elevation of *Bifidobacterium* has been demonstrated upon supplementation of prebiotic inulin in adults (Kolida *et al.* 2007; Kleeseen *et al.* 2007). Probiotics like inulin increases stool consistency and frequency in infants.

D-Tagatose

D-Tagatose (D-tag) is an isomer of fructose that is used as a Food and Drug Administration (FDA) approved nutritional sweetener. It is nutritional due to its low calorific value and considered as sweetener as it is 90% sweeter than sucrose. Lu *et al.* (2008) reported that only 20% of the orally ingested tagatose is metabolized completely in the liver. D-tag is widely used as a sweetener in beverages, yogurt, creams, and dietetic candy. Wyss *et al.* (2018) experimentally demonstrated that D-tag directly inhibits the absorption of glucose by intestinal disaccharidases in type 2 diabetic patients.

Litchi

Litchi is one of the most popular fruits which is grown in various parts of the world for its great taste and nutritional benefits. Litchi is considered as functional food because of its anti-tumor activities, which is demonstrated in both *in-vitro* and *in-vivo* studies (Emanuele *et al.* 2017). Not only the edible pulp, but also the peel and seed of litchi contain beneficial antioxidants,anti-cancer, anti-microbial and anti-inflammatory functions. Emanuele *et al.* (2017) postulated that the antitumor activity of litchi may arrest cell cycle or have tumor targeting pro-apoptotic action which might be dependent on unbalanced redox equilibrium. Anti-tumor agents are capable of inducing oxidative stress and promote tumor cell death (Manda *et al.* 2015). Anantharaju *et al.* (2016) reported that antioxidant and anti-tumor activity of litchi pulp extracts is due to the presence of polysaccharides as well as bioactive phenolic compounds, especially polyphenols. Polyphenols are rich in micronutrients with antioxidant properties. Zhang *et al.* (2013), demonstrated antioxidant activity of litchi pulp by Frap assay and detected six individual phenolic compounds (gallic acid, chlorogenic acid, (+)-catechin, caffeic acid, (-)-epicatechin, and rutin) by high-performance liquid chromatography (HPLC).

Peanuts

Peanut is cultivated globally. The main functional constituents of peanut include proteins, fibers, polyphenols, antioxidants, vitamins and minerals - that can be added as a functional ingredient into many processed foods. Peanuts are rich source of resveratrol, phenolic acids, flavonoids and phytosterols that block the absorption of cholesterol from diet (Arya *et al.* 2016). It is also an excellent source of Co-enzyme Q10 and contains all the standard amino acids, arginine being the highest of all. Q10 protects heart in hypoxic conditions. These bioactive compounds have been recognized for having disease preventive properties and are thought to promote longevity. The processing of peanut which includes roasting and boiling, increase the concentration of these bioactive compounds. Fermented peanut meal (Zhang *et al.* 2011) has been used to study the antioxidant activity and free radical scavenging activity.

Resveratrol (3,5,4′-trihydroxy-trans-stilbene) found in peanuts belongs to polyphenols' stilbenoids group, possessing two phenol rings linked to each other by an ethylene bridge. It is a phytoalexin that is active against pathogens, including bacteria and fungi. Resveratrol possesses a very high antioxidant

potential (Malhotra *et al.* 2015) and exhibit antitumor activity. It is considered as a potential compound for prevention and treatment of several types of cancer (Kuršvietienė *et al.* 2016; Bishayee *et al.* 2009). Anticancer properties of resveratrol have been established by many *in vitro* and *in vivo* studies, which shows that resveratrol is able to inhibit all carcinogenesis at stages, i.e., initiation, promotion and progression (Arya *et al.* 2016).

Flaxseed

Flaxseed comes under functional food owing to the presence of three main bioactive components in it, namely, alpha-linolenic acid, lignans and dietary fibers. Alpha-linolenic acid serves as the sole source of omega-3 fatty acid in the vegetarian diets (Riediger *et al.* 2009). Flaxseed oil is found to be rich in polyunsaturated fatty acid (73 % of total fatty acid), moderate in monounsaturated fat (18 %) and low amount of saturated fat (9 %) (Cunnane *et al.* 1993; Dubois *et al.* 2007). Both the essential fatty acids—alpha-linolenic acid (ALA), and linolenic acid (LA) are present in flaxseed. Essential Fatty acids are those which are required by the human body but cannot be synthesized due to the lack of specific enzymes that help in synthesis of these essential fatty acids (de Lorgeril *et al.* 2001). Flaxseed is an exclusive source of potassium (5600–9200 mg/kg) as well as other minerals like phosphorous (650 mg/100 g), magnesium (350–431 mg/100 g), calcium (236–250 mg/100 g) and has very low amount of sodium (27 mg/100 g) (Morris, 2007). High potassium intake in diet is inversely related to blood platelet aggregation, free radicals in blood and stroke incidence (Carter, 1993). Moreover, high flaxseed is rich in dietary fibers which proves to be beneficial for the prevention of obesity in both men and women (Du *et al.* 2010).

Probiotics

Live microbes which are administered in appropriate amount as functional food ingredient to an individual so as to have a significant health benefit, are known as probiotics. Most frequenly used microorganisms in human nutrition are - *Lactobacillus* spp., *Bifidobacterium* spp., *Enterococcus* spp. Foods like yoghurt, cultured buttermilk, cheese, bacterial fermented Japanese miso, tempeh, sauerkraut, beer, sour dough, bread, chocolate, kimchi, olives, pickles, krefir, etc. are common source of probiotics. Among all these yoghurt occupies the top position as it maintains a low ph micro-environment which is favourable for probiotic bacteria to survive (Anandharaj *et al.* 2014). Probiotic exhibit diverse mode of action – (a) enhancement of epithelial barrier function; (b) increased adhesion to intestinal epithelial cells; (c) competitive exclusion of pathogenic microorganisms; (d) production of anti-microbial peptides; (e) modulation of immune system; (f) interference with quorum sensing signalling molecules (Syngai *et al.* 2016). Probiotics have several beneficial effects on human health such as – cholesterol reduction; lactose digestion; anti-carcinogenic activity; prevention of osteoporosis, rotaviral diarrhea, skin problem, respiratory diseases, urogenital infection, exogenous and endogenous pathogens, irritable bowel syndrome; synthesis of vitamin B2, B6, B12; stimulate innate immunity; support digestion process; improve resistance to allergies (Anandharaj *et al.* 2014).

CONCLUSION

The term nutraceutical was introduced by Stephen L. DeFelice, founder chairman of the "Foundation of Innovation Medicine." in the year 1989 (Sharma *et al.* 2016). Though the concept is very old, research and development on functional food or nutraceuticals are now reaching its peak. Research are trying to produce engineered, processed foods and beverages which are enriched in vitamins and other health promoting bioactive ingredients. Fresh foods like vegetables, fruits, and fermented foods inoculated with live cultures of bacteria are in high demand as they have probiotic benefits. Nutraceuticals are trending in healthcare, food industries where there is an intersection of food and pharmaceutical industries. Phyto-chemistry is gaining more and more importance in current scenario as nutraceutical industries exploits a broad class of phytochemicals (phytoestrogens, terpenoids, limonoids, glucosinolates, polyphenols, etc.) which have beneficial effect on human health. Though the use of functional foods are in full swing, there are still some issues which needs scientific attention. Dose/response, delivery, toxicity, purity, safety, efficacy are of nutraceuticals need more extensive research with *in vitro* and *in vivo* model to standardize the outcomes.

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